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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
SONG, MATTHEW J	
ART UNIT	**PAPER NUMBER**
1765	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/047,323	Applicant(s) LAMPERT ET AL.	
	Examiner Matthew J Song	Art Unit 1765	

-- Th MAILING DATE of this communication appears on the cov r sh et with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-6* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-6* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kitabatake et al (US 6,270,573) in view of Gruen et al (US 5,620,512) and Shiomi et al (US 6,193,797) and Pickar (US 3,385,723).

Kitabatake et al discloses a method of growing a hexagonal silicon carbide on a hexagonal silicon carbide comprising introducing a substrate made of silicon carbide into a molecular beam epitaxy apparatus and heating at 1100°C to clean the substrate, this reads on preparing the substrate, with a background pressure of 10^{-9} or less, this reads on evacuating the chamber, supplying silicon atoms from a k-cell heated at 1380°C and carbon atoms were supplied from an electron beam evaporation device (col 10, ln 20-40). Kitabatake et al also discloses a homoepitaxial growth of silicon carbide by heating the substrate to 1600°C (col 11, ln 25-40). Kitabatake et al also discloses the supply sources of silicon atoms and carbon atoms are not limited and other supply source gases may also be employed, such as silane, propane, acetylene and the like (col 12, ln 45-51).

Kitabatake et al is silent to the effusion cells having shutters. Effusion cells with shutters are well known in the art to be inherent to molecular beam epitaxy, note Schultz et al US 5,985,356 (col 15, ln 65 to col 16, ln 15).

Kitabatake et al does not teach a first crucible with a quantity of Fullerenes.

In a method of forming a film, Gruen et al teaches a method of forming a diamond film by chemical vapor deposition from the decomposition of fullerene molecules (col 2, ln 1-5). Gruen et al also teaches a fullerne containing vapor **18** can be introduced into a deposition chamber by heating a sublimator **14** to a temperature adequate to cause fullerene sublimation, such as 550°C (col 2, ln 50-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kitabatake et al with Gruen et al because using a pure carbon source of fullerenes reduces the possibility of defects occurring from the presence of hydrogen or oxygen by using other sources, such as propane or acetylene ('512 col 1, ln 30-60) and using a pure carbon supply can greatly reduce the concentration of impurities in a SiC single crystal (US 6,193,797 col 10, ln 25-47).

Kitabatake et al does not teach a second crucible with a quantity of solid Si.

In a method of forming a SiC single crystal, Shiomi et al teaches a Si source **12** in a cylindrical bulk is accommodated within a Si-holding crucible **3** formed of diamond-like carbon or glass-like carbon (col 7, ln 24-30 and col 8, ln 9-25). Shiomi et al also teaches the temperature of the Si source is set to a temperature of 1300°C to 1600°C (col 40-50). Shiomi et al also teaches a Si source **12** and a carbon supply source **15** can be made of highly pure material which can greatly reduce the concentration of impurities in a SiC crystal (col 10, ln 29-45). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kitabatake et al with Shiomi et al because using a Si source made of highly pure materials can greatly reduce the concentration of impurities in a SiC crystal.

Kitabatake et al does not teach a second crucible with layer of SiC.

In a method of reducing impurities in a Silicon melt, Pickar teaches a method of producing carbon articles having a protective coating against highly reactive gases or liquids at high temperatures. Pickar also teaches a pure graphitic crucible having a coating of polycrystalline beta silicon carbide in which molten silicon or other highly reactive liquids can be maintained for many hours at high temperatures without causing introduction of impurities into the melt (col 1, ln 20-72). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kitabatake et al with Pickar to prevent introducing impurities into a silicon raw material.

Referring to claim 2, the combination of Kitabatake et al, Gruen et al, Shiomi et al and Pickar teaches heating substrate to 1600°C to homoepitaxially grow SiC, overlapping ranges are held to be obvious (MPEP 2144.05).

Referring to claim 3, the combination of Kitabatake et al, Gruen et al, Shiomi et al and Pickar teaches sublimating fullerene at 550°C.

Referring to claim 4, the combination of Kitabatake et al, Gruen et al, Shiomi et al and Pickar teaches heating a solid silicon source to a temperature of 1600°C.

3. Claim 5 rejected under 35 U.S.C. 103(a) as being unpatentable over Kitabatake et al (US 6,270,573) in view of Gruen et al (US 5,620,512) and Shiomi et al (US 6,193,797) and Pickar (US 3,385,723) as applied to claims 1-4 above, and further in view of Powell et al (US 5,915,194).

The combination of Kitabatake et al, Gruen et al, Shiomi et al and Pickar teaches all of the limitations of claim 5, as discussed previously, except the substrate is prepared by chemical mechanical polishing.

In a method of preparing SiC substrates for epitaxial growth of SiC, Powell et al teaches a SiC substrate **24** is pretreated to remove contaminants or impurities on the surface to facilitate the growing of high-quality, low defect epitaxial films, where various pregrowth treatments such as oxidation, chemical mechanical polishing or reactive ion etching may be used to remove potential unwanted nucleation sites prior to growth the crystal epilayers (col 11, ln 45-65). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Kitabatake et al, Gruen et al, Shiomi et al and Pickar with Powell et al to remove impurities on the surface of the substrate to facilitate the growing of high-quality, low defect epitaxial layers.

4. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kitabatake et al (US 6,270,573) in view of Gruen et al (US 5,620,512) and Shiomi et al (US 6,193,797) and Pickar (US 3,385,723) further in view of Powell et al (US 5,915,194) as applied to claim 5 above, and further in view of Fissel et al (Low temperature growth of SiC thin films on Si and 6H-SiC by solid source molecular beam epitaxy).

The combination of Kitabatake et al, Gruen et al, Shiomi et al, Pickar and Powell et al teaches all of the limitations of claim 6, as discussed previously, except etching the substrate, rinsing the substrate, and drying the substrate.

In a method of growing SiC by solid source MBE on a 6H SiC substrate, Fissel et al teaches cleaning a SiC wafer prior to loading into a UHV apparatus, where the SiC substrates were scrubbed with liquid detergent, HF-dipped, cleaned in hot hydrochloric acid, treated with hot $H_2SO_{4=}$-HNO_3 solution and again HF-dipped, this reads on etching. Fissel et al also teaches between the each cleaning step the samples were rinsed with de-ionized water and the samples were heated to 600°C for 30 mins before loading into the deposition chamber, this reads on drying (pg 3182 col 2). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Kitabatake et al, Gruen et al, Shiomi et al, Pickar and Powell et al with Fissel et al to clean the substrate prior to deposition to remove impurities on the substrate, thereby improving the quality of the deposited SiC.

5. Claims 1-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kitabatake et al (US 6,270,573) in view of Gruen et al (US 5,620,512) and Shiomi et al (US 6,193,797) and Pickar (US 3,385,723) as applied to claim 1 above, and further in view of Schultz et al (US 5,985,356).

The combination of Kitabatake et al, Gruen et al, Shiomi et al and Pickar teaches all of the limitations of claim 1, as discussed previously, except the well know feature of effusion cells with shutters, which is inherent to the molecular beam epitaxy method of deposition.

In a molecular beam epitaxy method (MBE), Schultz et al teaches in a MBE method, films are formed on single crystal substrates by slowly evaporating elemental constituents of the film from separate Knudsen effusion cells (deep crucibles in furnaces with cooled shrouds) onto to substrates and fast shutters are interposed between the sources and the substrate. Schultz et al

also teaches by controlling these shutters one can precisely control the thickness down to the level of atomic layers (col 15, ln 65 to col 16, ln 15). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Kitabatake et al, Gruen et al, Shiomi et al and Pickar with Schultz et al to control the thickness of the deposited film.

6. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kitabatake et al (US 6,270,573) in view of Gruen et al (US 5,620,512) and Shiomi et al (US 6,193,797) and Pickar (US 3,385,723) and Powell et al (US 5,915,194) and Fissel et al (Low temperature growth of SiC thin films on Si and 6H-SiC by solid source molecular beam epitaxy) as applied to claim 6 above, and further in view of Schultz et al (US 5,985,356).

The combination of Kitabatake et al, Gruen et al, Shiomi et al, Pickar and Fissel teaches all of the limitations of claim 6, as discussed previously, except the well know feature of effusion cells with shutters, which is inherent to the molecular beam epitaxy method of deposition.

In a molecular beam epitaxy method (MBE), Schultz et al teaches in a MBE method, films are formed on single crystal substrates by slowly evaporating elemental constituents of the film from separate Knudsen effusion cells (deep crucibles in furnaces with cooled shrouds) onto to substrates and fast shutters are interposed between the sources and the substrate. Schultz et al also teaches by controlling these shutters one can precisely control the thickness down to the level of atomic layers (col 15, ln 65 to col 16, ln 15). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Kitabatake et al,

Gruen et al, Shiomi et al, Pickar and Fissel et al with Schultz et al to control the thickness of the deposited film.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Shewchun et al (US 3,949,119) teaches a charge of silicon is placed in a crucible of an electron beam gun evaporator and a material is deposited on a heated substrate (col 1, ln 20-35).

Kitabatake (US 6,273,950) teaches carbon atoms were vaporized from an electron beam evaporator apparatus, in which a crucible filled with graphite chucks was irradiated by an electron gun and molecular carbons were supplied to a substrate surface (col 19, ln 55-67).

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 703-305-4953. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin L Utech can be reached on 703-308-3868. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Matthew J Song
Examiner
Art Unit 1765

MJS
January 9, 2003

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